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Abstract

It has been argued that China may stop financing the US external deficit, appreciate the currency, increase consumption and move its economy away from tradables and towards nontradables. Our two-country model shows that paradoxically this policy option is unattractive if the US authorities keep monetary policy sufficiently loose, thus reducing the real value of the US liabilities held by China. As long as the American and Chinese authorities pursue complementary objectives, the current China-US arrangement continues. In addition, an untimely appreciation of China's real exchange rate may have negative consequences on employment in the US and in China.

Keywords: China-US co-dependency; global imbalances; reserve accumulation; external debt.

JEL codes: F32, F41

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1. INTRODUCTION

It has been argued that China may be tempted to stop financing the US external deficit, increase its consumption, and move its economy away from tradables and towards nontradables. In this paper we present a two-country model that shows that this policy option can be unattractive if the US monetary policy is sufficiently loose. This conclusion may sound paradoxical in the light of some conventional wisdom maintaining that US quantitative easing could induce the Chinese authorities to reverse their current policy of accumulating US financial assets (see Figure 1). However, this result sheds some light on the reasons why the Chinese policymakers have so far held on to their strategy and probably will continue to do so for a while.

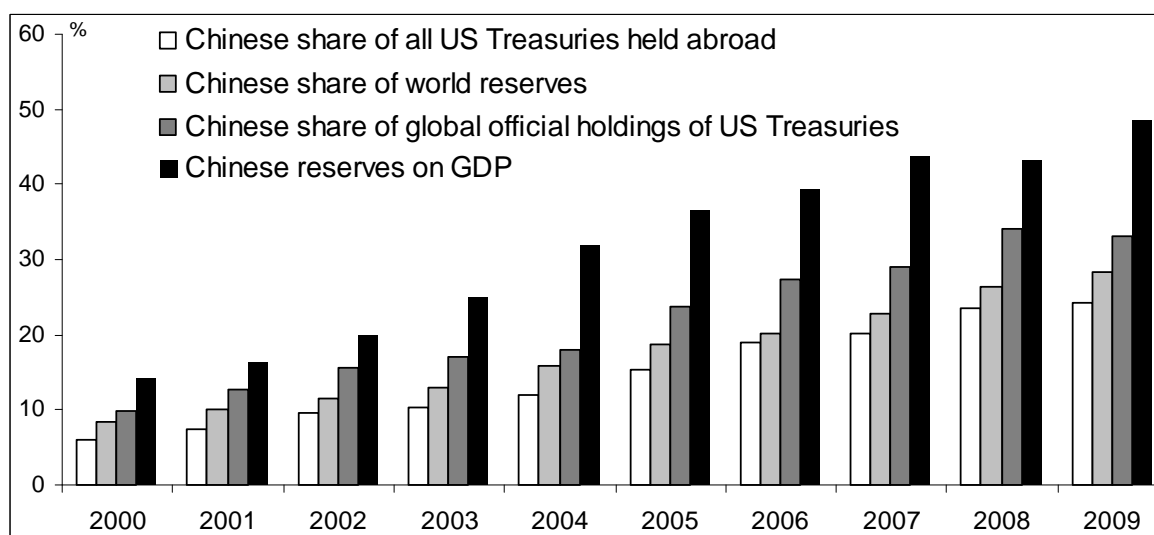


Figure 1. Chinese official reserves and holdings of US Treasuries. Sources: IMF IFS and US Treasury (TIC)

The resurgence and the persistence of large current account imbalances, and in particular of the highly unbalanced relationship between China and the US (with China recently accounting for more than 40% of US current account deficits), have been widely investigated. According to the literature, global imbalances owe both to global factors – for instance, the lack of sound non-US investment opportunities after the Asian crisis (Caballero et al., 2008; Mendoza et al., 2009) and the emergence of a global saving glut in the 2000s (Bernanke, 2005)-, and to country-specific domestic determinants, such as the extremely high (low) saving rates in China (US) (Blanchard and Giavazzi, 2006; Chamon and Prasad, 2010; Roubini and Setser, 2004; Laibson and Mollerstrom, 2011) and

the undervaluation of the Chinese currency (Blanchard et al., 2005; Obstfeld and Rogoff, 2007; Rodrik 2008).¹ As argued elsewhere (Bonatti and Fracasso, 2010a), these domestic determinants should not be interpreted in isolation but rather in the light of the policy regimes adopted by the authorities to pursue their country-specific political objectives.

Focusing on the US and China for the sake of simplicity, this amounts to arguing that persistent external imbalances are rooted in the symbiotic relationship between the different growth paradigms adopted in the two countries, in line with the “Sino-American co-dependency” view proposed by Dooley et al. (2003, 2004a,b, 2009). China has purposefully maintained an undervalued exchange rate (mainly against the US dollar)² to foster its economic growth, through export promotion, and to facilitate the mobilization of its labour force into the highly productive sectors of the economy. To this end, China has tightly controlled the international financial flows and accumulated (and sterilised) an impressive amount of foreign exchange rate reserves, equal to about \$3 trillion in early 2011.³ The US, in turn, has exploited the Chinese willingness to finance its current account deficits so as to maintain high domestic consumption, while ensuring low yields on US Treasury bonds. As claimed by Feldstein (2011), the US large external deficits reflected a combination of public budget deficits and low household saving, this latter in turn influenced by government policies discouraging personal saving.

There has been a widespread consensus in the literature and among political commentators that the massive accumulation of foreign reserves pursued by China has reflected both mercantilist and self-insurance purposes (Aizenman and Lee, 2008). Not much attention, however, has been given to the reasons why this strategy has been carried on for such a long period of time (and to the

¹ See Blanchard and Milesi-Ferretti (2009) and Eichengreen (2006) for an overview.

² In 1994/1995, the Chinese authorities started pegging the renminbi to the US dollar. The peg was substituted by a managed float with reference to a basket of currencies in 2005. The renminbi has gradually appreciated, passing from 8.28 RMB per dollar in 2005 to 6.5 RMB per dollar in February 2011. For an overview of the evolution of the Chinese exchange rate regime, see Ferguson and Schularick (2009), Frankel (2009), Frankel and Wei (2007).

³ According to Prasad and Sorkin (2009), Chinese current account surpluses accounted for 91% of the huge accumulation of exchange rate reserves occurred from 2004 to 2008.

observed extent) despite its inherent costs.⁴ In this work, we tackle this issue by developing an original two-country two-period macroeconomic model able to trace some qualitative aspects of the Sino-American co-dependency story (such as the export-led growth due to an undervalued exchange rate and sterilised reserves accumulation, marked consumption repression and high household savings in China, and a large trade deficit and overconsumption in the US). We investigate whether reserves hoarding has served the Chinese policy goals and has been compatible with the US ones: we show that this has been the case, at least as far as the Chinese and US policy objectives can be summarized as the maximisation, respectively, of domestic GDP and of domestic consumption. The juxtaposition of different policy objectives helps to understand why China has not yet stopped financing the US external deficits to increase Chinese consumption by depleting the stock of foreign reserves (thus, moving the economy from the production of tradables towards nontradables).⁵

In a nutshell, the model reveals that, provided the Chinese authorities aim to maximize the size of domestic GDP rather than consumption (as confirmed by the remarkable and persistence repression of private consumption), they better gear a policy regime that concentrates the labour force in either one of tradable and nontradable sectors as GDP tends to be higher when labour is unevenly allocated across the tradable and nontradable sectors. Importantly, the private choices and the policy measures adopted in the US affect which sector China should aim to foster. Thus, if the US authorities want to maximise the consumption of the US consumers, they have an incentive to conduct a sufficiently loose monetary policy so as to make relatively convenient for China to adopt and maintain an export-led growth strategy. If the US monetary policy is too tight, the real value of

⁴ A number of studies advocated a rapid rebalancing of the Chinese growth away from external demand and investment, and toward domestic demand and consumption (see, among the others, Blanchard and Giavazzi, 2006; Prasad, 2009; Prasad and Rajan, 2006; Straub and Thimann, 2010; Zheng et al., 2009), on the basis that the costs associated with the maintenance of the strategy would be larger than those stemming from a reversal of the policy.

⁵ In addition, we show in a companion paper (Bonatti and Fracasso, 2010b) that reverting the Chinese strategy might have some undesirable consequences on both countries: the Chinese rate of growth may be reduced and the maintenance of full employment and high levels of consumption in the US may be jeopardized.

the US financial assets held by China may increase and lure the Chinese authorities to deplete the accumulated stocks of US assets, to stop financing the US external deficit and to let appreciate the currency.

This theoretical model allows to depict the past and current relationship between the Sino-American exchange rate regime, on the one hand, and the policy objectives of the authorities both in the US and in China, on the other hand. However, the model is also conducive to predictions that help appreciate the future evolution of the China-US co-dependency. For instance, the model suggests that, unless a deflationary process takes place in the US or unless the Chinese authorities decide to let domestic consumption expand more rapidly than in the past, the current Chinese strategy will not be rapidly reversed and China will keep on accumulating US assets. To make sure that a policy reversal will not occur (as this would reduce consumption opportunities to the US citizens), the American authorities have an incentive to conduct a sufficiently loose monetary policy. This is not, as often thought, out of an attempt to inflate the debt away,⁶ but rather in order to preserve the convenience for China to stick to its export-led *cum* reserve accumulation growth strategy.

Aizenman and Lee (2010) represents the closest attempt to investigate the reasons why a mercantilist approach, characterised by an undervalued exchange rate and the accumulation of foreign reserves, has so far represented a viable policy regime for the Chinese authorities. The authors show that a learning-by-doing externality in the production of tradables calls for an undervalued exchange rate because the latter may be used as a tool to internalize the externality. Besides the different mechanisms driving growth in their and in our models, our work differs from theirs in that we consider both the US and the Chinese objectives and policy measures and their interaction, rather than focusing on China in isolation. This is of utmost importance if the Sino-US unbalanced relationship is to be interpreted as the result of a mutually beneficial relationship between countries pursuing different, but complementary goals.

⁶ On the possibility that the US may inflate its debt away, see e.g. Aizenman and Marion (2009).

Without stretching the model too much, some lessons for the future of the Sino-US relationship could be drawn from our analysis. The first one is that the duration of the exchange rate undervaluation *cum* reserve accumulation strategy is not determined by the size of the Chinese foreign reserves *per se*. In fact, it is mainly influenced by the convenience for the Chinese authorities to maintain their productive specialization on tradables and keep consumption compressed rather than expand the production of nontradables and domestic consumption. Second, we show that this convenience depends also on the US monetary policy stance. The third lesson is that the standard of living that the Chinese authorities desire to guarantee to their citizens is key to determine the likelihood of a policy regime change: the higher the pursued standard, the more likely the occurrence of a reversal. Finally, given that in the US a larger share of the labour force is employed in the nontradable sector than in China, the immediate effects of an appreciation of the renminbi on total employment may be negative in both countries, thereby increasing the number of unemployed people in the US and swelling the ranks of workers employed in the backward sectors of the Chinese economy.

The remainder of the paper proceeds as follows. The building blocks and the derivation of the model are discussed in section 2, while the characterization of the equilibrium is presented in section 3. Section 4 concludes.

2. THE MODEL

The world economy includes two countries, US and China. Three market goods are produced in this world economy: an internationally tradable good that is produced in both countries, an (internationally) nontradable good that is produced and sold in US, and an (internationally) nontradable good that is produced and sold in China. Hence, in both countries there are firms specialized in the production of tradable goods and firms specialized in the production of nontradable goods. The tradable good is used as capital in the production of both goods and as

consumption good, while the nontradable good can be only consumed.⁷ Labour is internationally immobile but can freely move across sectors within each country. Labour that is not employed in the two market sectors undertakes non-market activities. In the case of China, the latter can be interpreted as those low-productive activities that are typical of rural areas.

Goods and labour markets are perfectly competitive. Both countries are populated by households that supply labour, buy the consumer goods, accumulate financial assets and hold money. Moreover, each country has its own government sector. The policy regime governing the world financial markets is characterized by the fact that the Chinese authorities fix the nominal exchange rate and permit only official transactions in financial assets. In line with their public announcements and actual choices, we assume that the Chinese authorities aim at reaching the highest level of GDP that is consistent with the achievement of an acceptable level of households' consumption. Indeed, this objective is functional to fasten China's catching-up and to enhance its international *status*, although it has costs in terms of households' welfare. In contrast, the US authorities are assumed to maximize the consumption of the representative household.

There is no source of random disturbances and agents' expectations are rational (in the sense that they are consistent with the true processes followed by the relevant variables), thus implying perfect foresight.⁸ Finally, time is discrete and—for the sake of simplicity but without loss of generality—two periods are considered: the present and the future.

⁷ As argued by Turnovsky (1997), there is no agreed conclusion on the share of tradables and nontradables in total investment. For some evidence on the issue, see Bems (2008).

⁸ The distinction between two main sectors (tradables and nontradables) and the assumption that labour is mobile across sectors but not across countries while the capital good is mobile both across sectors and countries are consistent with the standard trade model developed by Obstfeld and Rogoff (1996, Chapter 4). We extend this framework by introducing a technological spillover in both sectors.

Firms producing the (internationally) nontradable good

In each country j , $j=us, ch$, there is a large number (normalized to be one) of identical firms, which—in each period t , $t=0,1$ —produce the nontradable good Y_{jNt} . This good is not storable and must be immediately consumed.⁹ Firms produce Y_{jNt} according to the following technology:

$$Y_{jNt} = A_{jNt} K_{jNt}^{1-\gamma_j} L_{jNt}^{\gamma_j}, 0 < \gamma_j < 1, \quad (1)$$

where K_{jNt} and L_{jNt} are, respectively, the capital stock and the labour input used in country j to produce the (internationally) nontradable market good Y_{jNt} , and A_{jNt} is a variable measuring the state of technology of the firms operating in that sector of country j which produces the (internationally) nontradable good Y_{jNt} . It is assumed that A_{jNt} is a positive function of the capital installed in the sector of j which produces Y_{jNt} : $A_{jNt} = K_{jNt}^{\gamma_j}$.¹⁰ This assumption combines the idea that learning-by-doing works through each firm's capital investment and the idea that knowledge and productivity gains spill over instantly across all firms (see Barro and Sala-i-Martin, 1995). Therefore, in accordance with Frankel (1962), it is supposed that although A_{jNt} is endogenous to the economy, each firm takes it as given, since a single firm's decisions have only a negligible impact on the aggregate stock of capital of the nontradable sector.¹¹

In each t , the net profit (cash flow) π_{jNt} of the representative firm producing nontradables is given by:

$$\pi_{jNt} = P_{jNt} Y_{jNt} - W_{jt} L_{jNt} - P_{jTt} I_{jNt}, I_{jNt} \geq 0, \quad (2)$$

⁹ Typically, consumer services are consumed while they are produced.

¹⁰ Consistently with this formal set-up, one can interpret technological progress as labour augmenting.

¹¹ This amounts to say that technological progress is endogenous to the economy, although it is an unintended by-product of firms' capital investment rather than the result of purposive R&D efforts.

where P_{jNt} and P_{jTt} are, respectively, the price of the nontradable good and the price of the tradable good in country j at time t , W_{jt} is the nominal wage in country j at time t , and I_{jNt} is capital investment by the representative firm producing nontradables in country j at time t .

The capital stock installed in the nontradable sector evolves according to

$$K_{jNt+1} = I_{jNt} + (1 - \delta_j)K_{jNt}, \quad 0 \leq \delta_j \leq 1, \quad K_{jN0} \text{ given.} \quad (3)$$

Firms decide on $L_{jN0}, L_{jN1}, I_{jN0}$ and I_{jN1} subject to (3) in order to maximize their discounted sequence of net profits

$$\pi_{jN0} + \frac{\pi_{jN1}}{(1 + i_{j1})}, \quad (4)$$

where i_{jt} is the nominal interest rate in country j at time t .

Firms producing the (internationally) tradable good

In each country j , there is a large number (normalized to be one) of identical firms producing the (internationally) tradable good Y_{jTt} . In each period t , these firms produce Y_{jTt} according to the following technology:

$$Y_{jTt} = A_{jTt} K_{jTt}^{1-\alpha_j} L_{jTt}^{\alpha_j}, \quad 0 < \alpha_j < \gamma_j, \quad (5)$$

where K_{jTt} and L_{jTt} are, respectively, the capital stock and the labour input used in country j to produce the (internationally) tradable market good Y_{jTt} . Notice that it is assumed that the labor elasticity of output is larger in the sector producing nontradables than in the sector producing tradables. Finally, A_{jTt} is a variable measuring the state of technology of the firms operating in that sector of country j which produces the (internationally) tradable good Y_{jTt} . Finally, A_{jTt} is a positive function of the capital installed in the sector of j which produces Y_{jTt} : $A_{jTt} = K_{jTt}^{\alpha_j}$.

In each t , the net profit π_{jTt} of the representative firm producing tradables is given by

$$\pi_{jTt} = P_{jTt} Y_{jTt} - W_{jt} L_{jTt} - P_{jTt} I_{jTt}, \quad I_{jTt} \geq 0, \quad (6)$$

where I_{jTt} is capital investment by the representative firm producing tradables in country j at time t .

The capital stock installed in the tradable sector evolves according to

$$K_{jTt+1} = I_{jTt} + (1 - \delta_j) K_{jTt}, \quad 0 \leq \delta_j \leq 1, \quad K_{jT0} \text{ given.} \quad (7)$$

Firms decide on $L_{jT0}, L_{jT1}, I_{jT0}$ and I_{jT1} subject to (7) in order to maximize their discounted sequence of net profits

$$\pi_{jT0} + \frac{\pi_{jT1}}{(1 + i_{j1})}. \quad (8)$$

Households

Households live for two periods. Their large number living in country j is normalized to be one (population's size is constant).

Consumption and real money balances providing liquidity services enter the period utility function of the representative household of country j , u_{jt} :

$$u_{jt} = \ln(C_{jt}) + \chi_j \ln\left(\frac{M_{jt}}{P_{jt}}\right), \quad \chi_j > 0, \quad (9)$$

where M_{jt} and P_{jt} are, respectively, the household's nominal money holdings and the consumer price index in country j at time t , and C_{jt} is the consumption index for the households located in country j at time t . The consumption index is defined as

$$C_{jt} = C_{jNt}^{\eta_j} C_{jTt}^{1-\eta_j}, \quad 0 < \eta_j < 1, \quad (10)$$

where C_{jNt} and C_{jTt} are, respectively, the consumption of nontradables and the consumption of tradables by the representative household located in country j at time t . Notice that C_{jt} can be interpreted as a composite good. Given (10), P_{jNt} and P_{jTt} , the consumer price index P_{jt} is obtained by minimizing the expenditure necessary to buy one unit of C_{jt} :

$$P_{jt} = \frac{P_{jNt}^{\eta_j} P_{jTt}^{1-\eta_j}}{D_j}, \quad D_j \equiv \eta_j^{\eta_j} (1 - \eta_j)^{1-\eta_j}. \quad (11)$$

The amount of labour supplied by the representative household of country j in period t , L_{jt}^s , is determined as follows:

$$L_{jt}^s = \begin{cases} H_j & \text{if } \frac{W_{jt}}{P_{jt}} \geq V_{jt} \\ 0 & \text{otherwise,} \end{cases} \quad (12)$$

where H_j is the fixed time endowment of each household located in country j , and V_{jt} is the reservation wage for households located in j at time t . One could argue that this reservation wage is exogenously given and depends on labour productivity in non-market activities, which in the case of China may be interpreted as those activities typical of the traditional sector where low-productive technologies are utilized for subsistence consumption¹² (largely coincident with China's primary sector).

Besides determining L_{j0}^s and L_{j1}^s according to (12), the representative household decides on M_{j0} , C_{jN0} , C_{jT0} , B_{jH1} , M_{j1} , C_{jN1} , C_{jT1} and B_{jH2} in order to maximize its sequence of discounted utilities

$$u_{j0} + \theta_j u_{j1}, \quad 0 < \theta_j < 1, \quad (13)$$

satisfying the period budget constraints:

$$B_{jHt+1} + M_{jt} + P_{jNt}C_{jNt} + P_{jTt}C_{jTt} \leq (1+i_{jt})B_{jHt} + M_{jt-1} + \pi_{jNt} + \pi_{jTt} + L_{jt}W_{jt} - T_{jt}, \quad t=0,1, \quad (14)$$

B_{jH0} , i_{j0} , M_{j-1} given, and the condition:

$$B_{jHt+1} \geq \begin{cases} \min(-B_{usGt+1} - R_{cht+1}, 0) & \text{if } j = us, \\ \min(-B_{chGt+1}, 0) & \text{if } j = ch, \quad t = 0,1. \end{cases} \quad (15)$$

In (13)-(14), θ_j represents the subjective discount factor of country j 's households, B_{jHt} are the domestic financial assets accumulated during period $t-1$ by the representative household of country j and carried over into period t with nominal yield i_{jt} , L_{jt} are the units of labour worked by the representative household of country j in period t , T_{jt} are the net monetary transfers ("net taxes")

¹² The net utility that the representative household gets by undertaking the non-market activities is assumed to be zero.

from the representative household of country j to its government in t . In (15), B_{jGt} are the domestic financial assets accumulated during period $t-1$ by the j -country's government sector and carried over into period t with nominal yield i_{jt} , and R_{cht} are the Chinese foreign reserves, that is the US financial assets (denominated in US currency) accumulated during period $t-1$ by the Chinese government sector and carried over into period t with nominal yield i_{ust} . The condition (15) imposes a limit to the possibility of the private sector to go into debt. In particular, it implies that the US private sector may go into debt in period t ($B_{usHt+1} < 0$) only if in that period the Chinese accumulation of foreign assets exceeds the debt issued by the US public sector, i.e., if $-B_{usGt+1} - R_{cht+1} < 0$, while the Chinese private sector may go into debt in t ($B_{chHt+1} < 0$) only if in that period the Chinese public sector is willing to be a net holder of domestic financial assets, i.e., if $-B_{chGt+1} < 0$. This asymmetry in the possibility of the private sectors of the two countries to go into debt is due to the fact that the Chinese capital account is not liberalized: the only international transactions in financial assets that can take place are those operated by the Chinese authorities. Furthermore, notice that in each period the representative household of country j is entitled to receive the net profits earned by the firms located in its own country as dividend payments. It should be also apparent that nominal balances (no-interest bearing financial assets) M_{jt} are accumulated during period t and carried over into period $t+1$ because of the liquidity services that they provide to the households.

Government sector

At time 0, both governments implement their policies for the current period and announce their policies for period 1. The governments of the two countries have different policy objectives. In particular, the US authorities decide on M_{us0} , T_{us0} , B_{usG1} , M_{us1} , T_{us1} and B_{usG2} in order to maximize the US households' discounted sequence of consumption

$$C_{us0} + \theta_{us} C_{us1}, \quad (16)$$

satisfying the period budget constraints:

$$B_{usGt+1} \leq M_{ust} - M_{ust-1} + T_{ust} + (1+i_{ust})B_{usGt}, \quad t=0,1, \quad (17)$$

B_{usG0} , i_{us0} , M_{us-1} given, and—in accordance with (15)—the condition:

$$B_{usGt+1} \geq \min(-B_{usHt+1} - R_{cht+1}, 0), \quad t=0,1. \quad (18)$$

Moreover, the Chinese authorities decide on E_{ch0} , M_{ch0} , T_{ch0} , B_{chG1} , R_{ch1} , E_{ch1} , M_{ch1} , T_{ch1} , B_{chG2} and R_{ch2} in order to maximize China's discounted sequence of real GDP

$$\frac{GDP_{ch0}}{P_{ch0}} + \theta_{ch} \frac{GDP_{ch1}}{P_{ch1}},^{13} \quad (19)$$

satisfying $C_{ch0} \geq \underline{C}_{ch0}$, $C_{ch1} \geq \underline{C}_{ch1}$ (\underline{C}_{cht} is the minimum level of consumption that the Chinese authorities desire to guarantee to their citizens in period t), the period budget constraints:

$$B_{chGt+1} + E_{cht}R_{cht+1} \leq M_{cht} - M_{cht-1} + T_{cht} + (1+i_{cht})B_{chGt} + E_{cht}(1+i_{ust})R_{cht}, \quad t=0,1, \quad (20)$$

B_{chG0} , R_{ch0} , i_{ch0} , i_{us0} , M_{ch-1} given, and—in accordance with (15)—the conditions:

$$B_{chGt+1} \geq \min(-B_{chHt+1}, 0), \quad t=0,1, \quad (21)$$

$$R_{cht+1} \geq 0, \quad t=0,1. \quad (22)$$

In (19)-(20), $GDP_{jt} \equiv P_{jNt} Y_{jNt} + P_{jTt} Y_{jTt}$ is the nominal GDP of country j at time t , E_{jt} ($E_{jt}=1/E_{it}$, $i \neq j$) is the nominal exchange rate of country j at time t (the price in units of the j -country's currency of one unit of the i -country currency at time t). It should be recalled that the only international transactions in financial assets that can take place are those operated by the Chinese authorities, which can fix E_{cht} and adjust consistently their foreign asset holdings.

Markets equilibrium conditions

Markets for labour and for the nontradable good are purely domestic. In equilibrium, the labour market of country j is characterized or by $\frac{W_{jt}}{P_{jt}} > V_{jt}$ entailing $L_{jt} = L_{jNt} + L_{jTt} = H_j$, or by

¹³ Notice in (19) that the nominal GDP is deflated by the consumer price index.

$L_{jt}=L_{jNt}+L_{jTt}<H_j$ entailing $\frac{W_{jt}}{P_{jt}} = V_{jt}$. Equilibrium in the country j 's market for the nontradable good requires:

$$Y_{jNt}=C_{jNt}. \quad (23)$$

The market for the tradable good is internationally integrated. Equilibrium in this market requires:

$$Y_{usTt}+Y_{chTt}=C_{usTt}+C_{chTt}+I_{usNt}+I_{usTt}+I_{chNt}+I_{chTt}. \quad (24)$$

In this internationally integrated market, the one-price law must hold:

$$P_{jTt}=E_{jt}P_{iTt}, \quad i \neq j, \quad (25)$$

Money market equilibrium in country j requires that in each t money supply is equal to money demand:

$$M_{jt}^s = M_{jt}^d. \quad (26)$$

Equilibrium in the markets for financial assets requires

$$B_{usHt}+B_{usGt}+R_{cht}=0 \quad (27)$$

and

$$B_{chHt}+B_{chGt}=0. \quad (28)$$

Notice that the Chinese stock of foreign reserves is the counterpart of the US negative net foreign asset position, and that the Chinese net holdings of domestic assets are equal to zero.¹⁴

3. THE EQUILIBRIUM

The equilibrium solutions that we consider must satisfy:

¹⁴ Typically, the People's Bank of China seeks to compensate the accumulation of foreign reserves by selling sterilisation bills to domestic agents, so as to keep control over money supply. As a result of this kind of operations, it is normally the case that the government sector reduces its holdings of domestic assets, while private agents increase theirs. However, for our purposes, it is not necessary to model the specific modalities whereby the Chinese central bank controls the supply of money while accumulating foreign reserves. What is essential for us is that an increase in the government sector's holdings of foreign assets has its counterpart in an improvement of the country's trade account.

(i) Agents' rationality. In particular, they presume that both governments choose their policies by taking into account the private agents' decision rules, which in their turn incorporate the governments' policy rules (the solutions to the private agents' optimization problems can be found in the Appendix).

(ii) Time consistency. This is relevant since in this context there is no mechanism allowing governments to make credible pre-commitments. Hence, announcements of policies that are not time-consistent cannot be credible, and policy rules that are not self-enforcing cannot be equilibrium solutions to the agents' problem.

Furthermore, these equilibrium solutions are such that:

(iii) They do not account for the possibility of formal defaults. The fact that breaches of debt contracts are ruled out is an acceptable simplification, since in this context a) it is the consolidated (private+government sector) balance sheet of each national economy that matters, making immaterial how the holding of domestic asset ($B_{jHt} + B_{jGt}$) is divided up between private and government sector (hence, there is ample room for government policies that—by increasing the public debt—allow the households to reduce their liabilities and to be solvent, with no real effect on both economies), and b) the indebted country (the US) may always exploit the privilege of having its external debt denominated in its own currency by inflating it away, thus making unnecessary and unrealistic the option of a formal default.

(iv) They assume that in each period the US government acts as a Stackelberg leader vis-à-vis the Chinese government. In particular, this assumption intends to capture the realistic situation where the US authorities decide on their monetary policy by anticipating the optimal Chinese reaction to it in terms of nominal exchange-rate policy, money supply and accumulation of foreign reserves.

Period 1

To obtain time-consistent solutions, we solve the authorities' problems by backward induction, thus starting from period 1. As preliminary steps for solving these problems, we focus on some relations holding in equilibrium among variables belonging to each national economy.

First, one can verify (see the Appendix) that

$$L_{jNt} = l(L_{jTt}, K_{jTt}, K_{jNt}), \quad l_{L_{jTt}} < 0. \quad (29)$$

Equation (29) reflects the fact that in equilibrium a higher employment level in the tradable sector is accompanied by a fall in the relative price of the nontradables that leads to a lower level of employment in the nontradable sector.

Second, moving economy j away from the production of nontradables and towards the production of tradables is also associated in period 1 with an improvement of its trade account. Hence, one can check (see the Appendix) that

$$\frac{TA_{j1}}{P_{jT1}} = f(L_{jT1}, K_{jT1}, K_{jN1}), \quad f_{L_{jT1}} > 0, \quad (30)$$

where $TA_{jt} \equiv P_{jTt}(Y_{jTt} - C_{jTt} - I_{jNt} - I_{jTt})$ is the trade account of country j (denominated in j currency) at time t . The adjustment required in period 1 to have an equilibrium where country j produces less nontradables and more tradables implies that this country reduces its absorption.

Third, it is not surprising that in general a re-balancing leading country j to produce less nontradables and more tradables brings about a compression of current consumption. Indeed (see the Appendix):

$$C_{jt} = c(L_{jTt}, K_{jTt}, K_{jNt}), \quad c_{L_{jTt}} < 0. \quad (31)$$

An implication of (31) is that there exists an upper limit $\bar{L}_{chTt} = a(\underline{C}_{cht}, K_{chTt}, K_{chNt})$, $a_{\underline{C}_{cht}} < 0$, to the units of labour that according to the Chinese authorities it is desirable to allocate for the production of tradables. Notice that this upper limit is a negative function of the minimum level of consumption that the Chinese authorities desire to guarantee to their citizens.

Fourth, real GDP and the employment level in the tradable sector are linked by an U-shaped relationship (see the Appendix and Figure 2):

$$\frac{GDP_{jt}}{P_{jt}} = v(L_{jTt}, K_{jTt}, K_{jNt}), \quad v_{L_{jTt}} \begin{cases} < 0 & \text{if } L_{jTt} < \hat{L}_{jTt} \\ > 0 & \text{if } L_{jTt} > \hat{L}_{jTt}, 0 < \hat{L}_{jTt} < H_j, \end{cases} \quad (32)$$

where \hat{L}_{jT1} is that level of L_{jT1} at which country's j real GDP reaches its minimum. Equation (32) captures the fact that—given the stocks of capital installed in the two sectors—a country's real GDP is larger if labour is heavily concentrated either in the production of nontradables or in the production of tradables. This is because an equilibrium where the national economy is highly specialized in the production of nontradables (tradables) is possible—in the presence of technologies characterized by decreasing marginal productivity of labour—only if the relative price of the nontradable (tradable) good is extremely high. In other words, the quantity produced by the nontradable (tradable) sector is very large whenever the relative price of the nontradables (tradables) is very high, thus explaining why real GDP tends to be higher when labour is unevenly distributed across the two sectors than when it is evenly allocated in the production of the two goods.

We can now highlight some relations holding in equilibrium among variables belonging to the different countries.

We start by using (30) to rewrite (24), i.e., the condition for equilibrium in the world market for the tradable good, as

$$\frac{TA_{ch1}}{P_{chT1}} + \frac{TA_{us1}}{P_{usT1}} = f(L_{chT1}, K_{chT1}, K_{chN1}) + f(L_{usT1}, K_{usT1}, K_{usN1}) = 0, \text{ to which one can apply the}$$

implicit function theorem so as to obtain:

$$L_{jT1} = n(L_{iT1}, K_{iT1}, K_{iN1}, K_{jT1}, K_{jN1}), \quad n_{L_{iT1}} < 0, \quad j \neq i. \quad (33)$$

Equation (33) establishes that, for keeping in equilibrium the world market for the tradable good, an increase in the employment level of country i 's tradable sector must be offset by a decrease in the employment level of country j 's tradable sector.

Secondly, we can use the equilibrium relationship between the price of the tradable good and the quantity of money $P_{jT1} = M_{j1}g(L_{jT1}, K_{jT1}, K_{jN1}), \quad g_{L_{jT1}} > 0$ (see the Appendix) to rewrite the

one-price law (25) as $g(L_{chT1}, K_{chT1}, K_{chN1}) - Q_1 g(L_{usT1}, K_{usT1}, K_{usN1}) = 0$, $Q_1 \equiv \frac{E_{ch1} M_{us1}}{M_{ch1}}$, to

which again one can apply the implicit function theorem so as to obtain:

$$L_{usT1} = h(Q_1, L_{chT1}, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), h_{Q_1} < 0, h_{L_{chT1}} > 0. \quad (34)$$

Equation (34) shows the channel whereby the Chinese authorities can influence how much tradable good is produced in the world economy and in which country is localized its production: given the US monetary policy, i.e., given M_{us1} , they can manoeuvre Q_1 in order to control their real exchange rate and affect employment and output in both countries.¹⁵

The possibility for the Chinese authorities to manoeuvre Q_1 for influencing employment and output in their country is more apparent by using (34) to rewrite the condition (24) for equilibrium in the world market for the tradable good as

$$f(L_{chT1}, K_{chT1}, K_{chN1}) + f(h(Q_1, L_{chT1}, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{usT1}, K_{usN1}) = 0, \text{ to}$$

which once again one can apply the implicit function theorem so as to obtain:

$$L_{chT1} = y(Q_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), y_{Q_1} > 0. \quad (35)$$

Equation (35) can be used for rewriting (33) as

$$L_{usT1} = n(y(Q_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), n_{L_{chT1}} y_{Q_1} < 0. \quad (36)$$

One can easily conclude from equations (35) and (36) that in period 1 the Chinese authorities can increase (depress) employment and production in the Chinese (US) tradable sector by setting a higher Q_1 , namely by depreciating their real exchange rate. However, one can see from (31), (35) and (36) that by doing so they depress (increase) the consumption of the Chinese (US) households. Hence, the Chinese authorities are not willing to depreciate their real exchange rate beyond a certain limit because otherwise they would compress the consumption of the Chinese households below an acceptable threshold: there exists an upper bound \bar{Q}_1 above which the Chinese authorities do not

¹⁵ The possibility by the Chinese authorities to exert a perfect control on the real exchange rate rests on their ability to fully sterilise any purchase of US assets.

intend to set Q_1 , where $\bar{Q}_1 = m(\underline{C}_{ch1}, K_{cht1}, K_{chN1}, K_{usT1}, K_{usN1})$, $m_{\underline{C}_{ch1}} < 0$, is that value of Q_1 satisfying $\bar{L}_{cht1} = a(\underline{C}_{ch1}, K_{cht1}, K_{chN1}) = y(Q_1, K_{cht1}, K_{chN1}, K_{usT1}, K_{usN1})$, and \underline{C}_{ch1} is assumed to be such that $\bar{L}_{cht1} > \hat{L}_{cht1}$. Notice that the level of \bar{Q}_1 depends negatively on \underline{C}_{ch1} : if the minimum standard of living that the Chinese authorities desire to guarantee to their citizens is higher, the limit beyond which they do not want to depreciate China's real exchange rate is more stringent.

It is straightforward that the accumulation of China's foreign reserves has to accommodate the real-exchange rate policy pursued by the Chinese authorities. This can be seen by noticing that China's foreign reserves evolve according to $R_{cht+1} - R_{cht} = i_{ust} R_{cht} - TA_{ust}$, from which—by dividing both sides by P_{usTt} —we obtain:

$$\frac{(1 + i_{ust})R_{cht} - R_{cht+1}}{P_{usTt}} = f(L_{usTt}, K_{usTt}, K_{usNt}). \quad (37)$$

By using (36) and the fact that $P_{usT1} = M_{us1} g(L_{usT1}, K_{usT1}, K_{usN1})$, $g_{L_{usT1}} > 0$ (see the Appendix), one can rewrite (37) as

$$\frac{(1 + i_{us1})R_{ch1} - R_{ch2}}{M_{us1} g(n(y(Q_1, K_{cht1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{cht1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{usT1}, K_{usN1})} = \quad (38)$$

$$= f(n(y(Q_1, K_{cht1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{cht1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{usTt}, K_{usNt})$$

In (38), a higher Q_1 has to be accommodated by an increase in R_{ch2} . In contrast, an appreciation of the Chinese real exchange rate (a lower Q_1) worsens China's trade account: in principle, the Chinese authorities may appreciate their real exchange rate up to the point where $R_{ch2}=0$, namely up to the point where their trade account deficit can be fully financed by the credits accumulated in the past vis-à-vis the US. Therefore, the level of Q_1 satisfying (38) when $R_{ch2}=0$, say \underline{Q}_1 , is the minimum at which the Chinese authorities can push Q_1 without becoming indebted to the US:

$$\underline{Q}_1 = q(M_{us1}, (1 + i_{us1})R_{ch1}, K_{usT1}, K_{usN1}, K_{usT1}, K_{usN1}), q_{M_{us1}} > 0, q_{(1+i_{us1})R_{ch1}} < 0. \quad (39)$$

The lower bound given by (39) represents the minimum at which the Chinese authorities can set Q_1 , since it is not in the interest of the US to lend to China so as to allow it to finance the trade deficit associated with $Q_1 < \underline{Q}_1$. Indeed, the consumption of the US representative household is such that

$$c(n(y(Q_1', K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{usTt}, K_{usNt}) > c(n(y(Q_1'', K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{usTt}, K_{usNt}) \quad (40)$$

for any Q_1' and Q_1'' such that $Q_1' > Q_1''$ (see Figure 2). The bound \underline{Q}_1 is associated with a lower limit $\underline{L}_{chT1} = y(\underline{Q}_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1})$ to the units of labour that the Chinese authorities can allocate for the production of tradables.

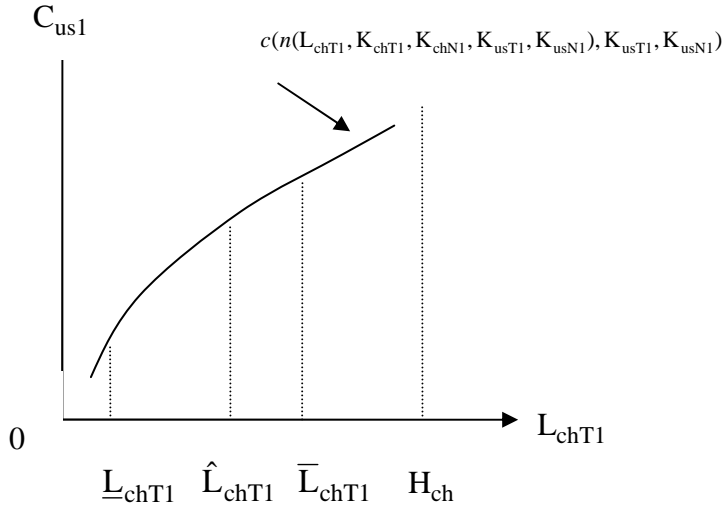


Figure 2. The relationship in period 1 between US consumption and employment in the Chinese tradable sector.

We are now ready to characterize the decision rule of the Chinese authorities in period 1. Indeed, considering the U-shaped relationship between real GDP and L_{jT1} given by (32), it is optimal for the Chinese authorities to set (see Figures 3 and 4):

$$Q_1 = \begin{cases} \bar{Q}_1 & \text{if } v(y(\bar{Q}_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}) > \\ & > v(y(\underline{Q}_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}) \\ \underline{Q}_1 & \text{if } v(y(\underline{Q}_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}) > \\ & > v(y(\bar{Q}_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}). \end{cases} \quad (41)$$

The rule (41) says that the Chinese authorities are going to depreciate their real exchange rate up to the point that guarantees the minimum acceptable level of consumption to the Chinese households

($Q_1 = \bar{Q}_1$), thus giving an export-led characterization to their economy, if in this way they can reach a higher level of real GDP than the level reachable by appreciating their real exchange up to the point that they cease to accumulate US assets ($Q_1 = \underline{Q}_1$), thus using the credits accumulated in the past to run a trade account deficit and to specialize China's economy in the production of nontradables.

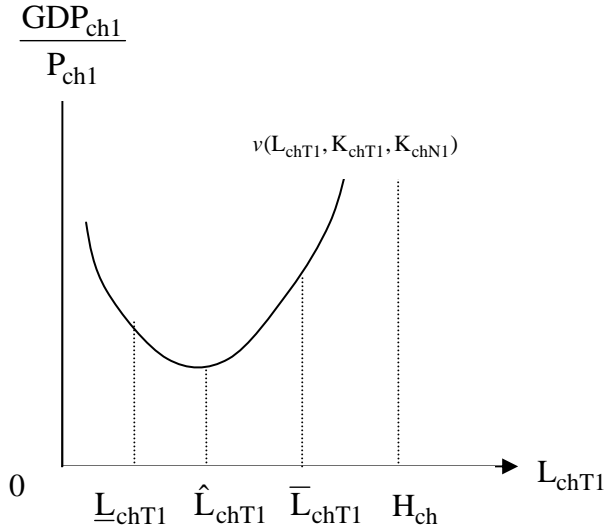


Figure 3. The decision rule of the Chinese authorities in period 1 (case in which $M_{us1} > \underline{M}_{us1}$)

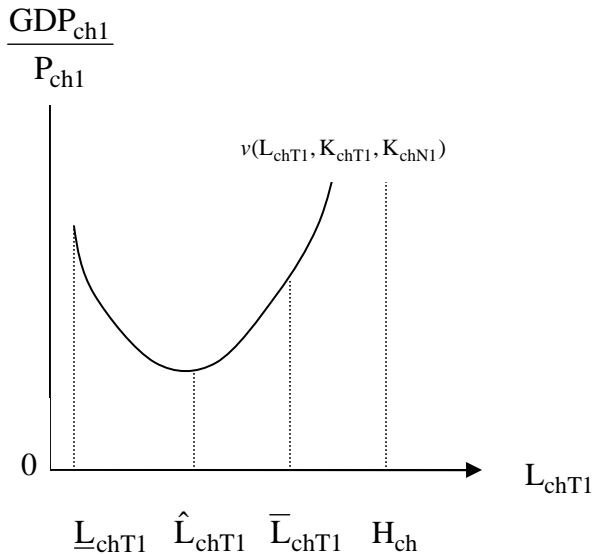


Figure 4. The decision rule of the Chinese authorities in period 1 (case in which $M_{us1} < \underline{M}_{us1}$)

The US authorities can influence the decision of the Chinese policy-makers. It is apparent, indeed, that it is in the interest of the US authorities to have $Q_1 = \bar{Q}_1$ (leading to $L_{chT1} = \bar{L}_{chT1}$)

rather than $Q_1 = \underline{Q}_1$ (leading to $L_{chT1} = \underline{L}_{chT1}$), since $\bar{Q}_1 > \underline{Q}_1$ (see (40) and Figure 2). To influence the Chinese authorities' decision, the US authorities can inflate the US external debt by increasing M_{us1} , thus augmenting \underline{Q}_1 (see (39)) and \underline{L}_{chT1} (see (35)): by reducing the real value of their outstanding debt, the US authorities may lower the benefit that the Chinese authorities can achieve by ceasing to accumulate US assets and running a trade account deficit financed with the credits accumulated in the past. In this way, the US authorities can make more convenient for their Chinese counterparts to set $Q_1 = \bar{Q}_1$, namely to continue in period 1 to accumulate US assets and to specialize their economy in the production of tradables. More precisely, it is optimal for the US authorities to set $M_{us1} > \underline{M}_{us1}$, where \underline{M}_{us1} is that value of M_{us1} satisfying

$$v(y(\underline{Q}_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}) = \\ = v(y(\bar{Q}_1, K_{chT1}, K_{chN1}, K_{usT1}, K_{usN1}), K_{chT1}, K_{chN1}) \quad \text{and} \quad \underline{Q}_1 \text{ is}$$

given by (39). It is also worth to stress that $\frac{\partial \underline{M}_{us1}}{\partial (1+i_{us1})R_{ch1}} > 0$: the larger are the credits that China

accumulated in the past, the larger has to be M_{us1} in order to induce the Chinese authorities to go on lending to the US.

Another way to look at the situation described above is by emphasizing that there is a limit to the possibility for the Chinese authorities to preserve their real variables from variations due to changes in the US monetary policy, by undertaking offsetting movements in $\frac{E_{ch1}}{P_{chT1}}$ and R_{ch2} that

keep Q_1 and $\frac{(1+i_{us1})R_{ch1} - R_{ch2}}{P_{usT1}}$ unchanged. Once $R_{ch2}=0$, any further increase in M_{us1} forces

China to appreciate its real exchange rate, thus reducing the maximum trade deficit (in units of the

tradable good) that it can run $\left(-f(L_{chT1}, K_{chT1}, K_{chN1}) = \frac{(1+i_{us1})R_{ch1}}{P_{usT1}} \right)$.

We may briefly summarize our discussion in the proposition below:

Proposition 1 The equilibrium emerging in the future (i.e., in period 1) is such that the US authorities will inflate the US external debt up to the point where the Chinese authorities have no convenience to stop accumulating US financial assets, and to use the credits accumulated in the past to increase China's current consumption and move its production away from tradables and towards nontradables.

Proof: see the discussion above.

Period 0

To save space, in period 0 we solve the model only for the case that is more realistic, namely the case where parameter values and initial conditions are such that the emerging equilibrium is characterized in both countries by some persistent “unemployment”, i.e., by the fact that both in period 0 and in period 1 some labour is not employed in the market sectors because real wages cannot be pushed below the reservation wages of the workers to insure full employment.

Differently than in period 1, in period 0 the authorities of both countries must take into account the effects of their policies on the accumulation of physical capital. However, the logic underlying the policy makers' behaviour in period 0 is similar to that dictating their choices in the final period. Indeed, China's sequence of discounted real GDP and policy-relevant levels of L_{chT0} are linked by an U-shaped relationship (see the Appendix):

$$\frac{GDP_{ch0}}{P_{ch0}} + \theta_{ch} \frac{GDP_{ch1}}{P_{ch1}} = b(L_{chT0}, K_{chT0}, K_{chN0}), b_{L_{chT0}} \begin{cases} < 0 \text{ if } L_{chT0} < \tilde{L}_{chT0} \\ > 0 \text{ if } L_{chT0} > \tilde{L}_{chT0}, 0 < \tilde{L}_{chT0} < H_{ch}, \end{cases} \quad (42)$$

where \tilde{L}_{chT0} is that level of L_{chT0} at which China's sequence of discounted real GDP reaches its

minimum. Moreover, by using $P_{jT0} = \frac{M_{j1}M_{j0}g(L_{jT0}, K_{jT0}, K_{jN0})}{(\theta_j M_{j0} + M_{j1})}$ (see the Appendix), one can

rewrite the one-price law (25) as $g(L_{chT0}, K_{chT0}, K_{chN0}) - Q_0 g(L_{usT0}, K_{usT0}, K_{usN0}) = 0$,

$$Q_0 \equiv \frac{E_{ch0}M_{us0}M_{us1}(\theta_{ch}M_{ch0} + M_{ch1})}{M_{ch0}M_{ch1}(\theta_{us}M_{us0} + M_{us1})}, \text{ thus showing that the Chinese authorities can manoeuvre } Q_0$$

in order to control their real exchange rate and affect employment and output in both countries.

Finally, one can check for relevant ranges of parameter values and initial conditions that given the

equilibrium that will emerge in period 1: i) $\frac{\partial \frac{TA_{ch0}}{P_{chT0}}}{\partial L_{chT0}} > 0$, ii) $\frac{\partial L_{usT0}}{\partial L_{chT0}} < 0$, and iii)

$\frac{\partial C_{us0} + \theta_{us} C_{us1}}{\partial L_{usT0}} < 0$. Therefore, also in period 0—as in period 1—there is a limit beyond which the

Chinese authorities are not willing to depreciate their real exchange rate for not pushing L_{chT0} above \bar{L}_{chT0} and C_{ch0} below \underline{C}_{ch0} , where \underline{C}_{ch0} is such that $\bar{L}_{chT0} > \tilde{L}_{chT0}$. Similarly, there exists a lower bound \underline{Q}_0 below which the Chinese cannot set Q_0 . Thus, also in period 0 the choice for the Chinese authorities is between two options, that is between setting $Q_0 = \underline{Q}_0$ or $Q_0 = \bar{Q}_0$, while for the US authorities it is convenient to manage M_{us0} so as to make less attractive for their Chinese counterparts the option of setting $Q_0 = \underline{Q}_0$, thus inducing them to set $Q_0 = \bar{Q}_0$ and accumulate US financial assets.

Employment implications

Let us suppose that there is an increase in the minimum standard of living that the Chinese authorities desire to guarantee to their citizens in the present (higher \underline{C}_{ch0}). This will lead to an appreciation of the Chinese real exchange rate (lower \bar{Q}_0), and in equilibrium to a lower L_{chT0} and a higher L_{usT0} . What are the immediate effects of this change on unemployment in the two countries? One can easily verify that

$$\frac{\partial(L_{jT0} + L_{jN0})}{\partial L_{jT0}} \begin{cases} > 0 \text{ if } L_{jT0} > \frac{(1-\eta_j)(1-\alpha_j)L_{jN0}}{\eta_j(1-\gamma_j)} \\ < 0 \text{ if } L_{jT0} < \frac{(1-\eta_j)(1-\alpha_j)L_{jN0}}{\eta_j(1-\gamma_j)}, \end{cases} \quad (43)$$

where $L_{jN0} = \left[\gamma_j K_{jN0} \left(\frac{D_j}{V_{j0}} \right)^{\frac{1}{\eta_j}} \left(\frac{\alpha_j K_{jT0}}{L_{jT0}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}}$ (see the Appendix). One can see from (43) that it

is more likely that a higher L_{jT0} boosts total employment in a country whose employment level in the nontradable sector is relatively low with respect to L_{jT0} because its initial endowments of capital in the two sectors are relatively poor with respect to its workers' reservation wage. Admitting that this is the situation of China, while the US is in the opposite situation having a larger share of their total employment in the nontradable sector, it is quite possible that the immediate effects of an appreciation of the Chinese real exchange rate on total employment are negative in both countries.

4. CONCLUSIONS

The accumulation of foreign reserves by the Chinese authorities has been part and parcel of the export-led growth strategy pursued to foster the expansion of the gross domestic product and the mobilization of the labour force from rural to more advanced activities. The US, in turn, has benefited from keeping consumption high through the accumulation of external deficits, to a large extent financed by China.

Our two-country two-period macroeconomic model captures the symbiotic relationship linking the US to China in recent years, reproduces some stylised aspects of the “Sino-American co-dependency”, and helps to rationalise the pros and cons of the accumulation of foreign reserves in China in the light of the policy objectives pursued by both the Chinese and the US authorities.¹⁶ Hence, this work contributes to the debate on global imbalances and on global rebalancing in that it originally focuses on the interdependence between the objectives and the policy strategies adopted in both countries, rather than treating them in isolation.

¹⁶ The model is stylised because, to keep it tractable and to provide more intuitive results, we neglect some aspects (avenues for future research) regarding the financial sectors in the US and in China, the behaviour of privately and publicly owned companies in China, and the differences between portfolio and FDI financial flows.

The model shows that, as long as the Chinese policy-makers attach more weight to increasing the economic size of their country than to boosting households' consumption, they have an interest in steering the Chinese economy towards the production of either tradables or nontradables, depending on the US policy actions. In particular, the model suggests that as long as the US monetary policy is not so tight that the real value of the US external debt exceeds a certain threshold, the Chinese authorities have a convenience to keep financing the US external deficits rather than appreciating the currency and depleting the accumulated stocks of foreign reserves.

It is worth stressing that we do not associate either of the two periods in the model with a specific span of time: the reason is that the theoretical model is kept general enough to be suitable both for analyzing the Sino-America co-dependency through an historical perspective (starting with the adoption on a fixed exchange rate regime with the currency pegged to the US dollar in 1994 and ending at the time of writing) and for assessing the implications of plausible future scenarios that differ in terms of key economic policy choices.

As regard the implications of the model for the future of the US-China relationship, a qualification is in order. Considering that hardly anybody would encourage the US monetary authorities to tight the monetary policy to the point to generate deflation, it could be argued that the abovementioned finding entails that the current Sino-American arrangement is unlikely to change in the predictable future. It should be kept in mind that this conclusion is valid *ceteris paribus*. In fact, some aspects of the current arrangement may change. First, the perfect sterilisation of an increasingly amount of foreign reserves (key to make the monetary policies in the two countries independent) may turn out to be too a demanding task for the Chinese monetary authorities.¹⁷ Second, the Chinese leadership may review the overall objectives for the country, attaching a larger (lower) weight to household's consumption (GDP growth) than in the past. (This possibility is indeed considered in the paper and we show that, under certain conditions, this occurrence may

¹⁷ China has maintained a high degree of domestic financial repression in order to facilitate the sterilisation of mounting foreign reserves and to drive the allocation of domestic investment across alternative uses. The distortions connected to these by-products of the sterilisation of the reserves might prove to be too high in the future.

negatively affect employment in both countries). Third, the growing riskiness associated with an increasing stock of US foreign debt (an issue that is admittedly not considered in the model) and the progressive decline of manufacturing sector in the US may lead to an overhaul of the US policy objectives in the medium and long term.

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APPENDIX

1) Solutions to the private agents' optimization problems

From the firms' first-order conditions with respect to labour, one can derive the relative price of the nontradable good in terms of units of the tradable good:

$$\frac{P_{jNt}}{P_{jTt}} = \frac{\alpha_j K_{jTt} L_{jNt}^{1-\gamma_j}}{\gamma_j K_{jNt} L_{jTt}^{1-\alpha_j}}, \quad t=0,1, \quad (A1)$$

By considering the firms' first-order conditions with respect to labour and the fact that the households' labour supply is determined according to (12), one can derive the employment level in the nontradable sector and the nominal wage:

$$L_{jNt} = l(L_{jTt}, K_{jTt}, K_{jNt}) = \begin{cases} H_j - L_{jTt} \text{ if } \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} + L_{jTt} > H_j \\ \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} & \text{otherwise, } t=0,1, \end{cases} \quad (A2)$$

$$W_{jt} = \begin{cases} \alpha_j P_{jTt} K_{jTt} L_{jTt}^{\alpha_j-1} \text{ if } \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} + L_{jTt} > H_j \\ \frac{P_{jTt}}{D_j} \left(\frac{\alpha_j K_{jTt} L_{jNt}^{1-\gamma_j}}{\gamma_j K_{jNt} L_{jTt}^{1-\alpha_j}} \right)^{\eta_j} V_{jt} & \text{otherwise, } t=0,1, \end{cases} \quad (A3)$$

where $\Phi_{jt} \equiv \left[\frac{\gamma_j}{\alpha_j} \left(\frac{\alpha_j D_j}{V_{jt}} \right)^{\frac{1}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}}$, and where one can easily check that $l_{L_{jTt}} < 0$. With reference to (A2),

we consider parameter values and stocks of capital satisfying

$$L_{jTt}^* + \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{(L_{jTt}^*)^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} < H_j, \quad (A4)$$

where $L_{jTt}^* = \left[\frac{(1-\alpha_j)(1-\eta_j)\Phi_{jt}}{\eta_j(1-\gamma_j)} \left(K_{jNt} K_{jTt}^{\frac{1-\eta_j}{\eta_j}} \right)^{\frac{1}{(1-\gamma_j)}} \right]^{\frac{\eta_j(1-\gamma_j)}{(1-\alpha_j)(1-\eta_j)+\eta_j(1-\gamma_j)}}$ is that value of $L_{jTt} < H_j$ which

minimizes $L_{jTt} + l(L_{jTt}, K_{jTt}, K_{jNt})$. By considering that $\frac{\partial^2 L_{jTt} + \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}}}{\partial L_{jTt}^2} > 0$ and that

$$L_{jTt} + \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} \rightarrow \begin{cases} H_j + \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{H_j^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} & \text{as } L_{jTt} \rightarrow H_j, \\ +\infty & \text{as } L_{jTt} \rightarrow 0 \end{cases} \quad \text{one can conclude from}$$

(A4) that there exists a unique pair (L_{jTt}^-, L_{jTt}^+) satisfying $0 < L_{jTt}^- < L_{jTt}^+ < H_j$ and

$$L_{jTt}^- + \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{(L_{jTt}^-)^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} = H_j = L_{jTt}^+ + \Phi_{jt} \left[K_{jNt} \left(\frac{K_{jTt}}{(L_{jTt}^+)^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}}. \quad \text{Notice that for any}$$

L_{jTt} such that $L_{jTt}^- < L_{jTt} < L_{jTt}^+$ one has unemployment in country j at time t .

By maximizing the firms' discounted sequence of profits with respect to the investment rate, one can obtain:

$$I_{usN1} = I_{usT1} = I_{chN1} = I_{chT1} = 0, \quad (A5)$$

$$P_{jT0} = \frac{(1-\alpha_j)P_{jT1}}{(1+i_{j1})} \left(\frac{\alpha_j P_{jT1} K_{jT1}}{W_{j1}} \right)^{\frac{\alpha_j}{(1-\alpha_j)}}, \quad (A6)$$

$$P_{jT0} = \frac{(1-\gamma_j)P_{jN1}}{(1+i_{j1})} \left(\frac{\gamma_j P_{jN1} K_{jN1}}{W_{j1}} \right)^{\frac{\gamma_j}{(1-\gamma_j)}}. \quad (A7)$$

By considering (1) and (23), one can easily check that

$$C_{jNt} = K_{jNt} L_{jNt}^{\gamma_j}, \quad t=0,1. \quad (A8)$$

By maximizing (13) subject to (14) with respect to C_{jTt} and C_{jNt} , one can use (A1) and (A8) to obtain:

$$C_{jTt} = \frac{(1-\eta_j)\alpha_j K_{jTt} L_{jNt}}{\eta_j \gamma_j L_{jTt}^{1-\alpha_j}}, \quad t=0,1. \quad (A9)$$

By maximizing (13) subject to (14) with respect to C_{jTt} and M_{j0} , one can use (A9) to obtain:

$$M_{j0} = \frac{\chi_j P_{jT0} C_{jT0} (1+i_{j1})}{(1-\eta_j) i_{j1}} = \frac{\chi_j P_{jT0} \alpha_j K_{jT0} L_{jN0} (1+i_{j1})}{\eta_j \gamma_j L_{jT0}^{1-\alpha_j} i_{j1}}. \quad (A10)$$

By maximizing (13) subject to (14) with respect to C_{jTt} and M_{j1} , one can use (A9) to obtain:

$$M_{j1} = \frac{\chi_j P_{jT1} C_{jT1}}{(1-\eta_j)} = \frac{\chi_j P_{jT1} \alpha_j K_{jT1} L_{jN1}}{\eta_j \gamma_j L_{jT1}^{1-\alpha_j}}. \quad (A11)$$

By maximizing (13) subject to (14) with respect to M_{j0} and M_{j1} , one can obtain:

$$i_{j1} = \frac{M_{j1}}{\theta_j M_{j0}}. \quad (A12)$$

Finally, by considering (13), (14) and (15), one can easily conclude that it is optimal for the representative household to set:

$$B_{jH2} = \begin{cases} \min(-B_{usG2} - R_{ch2}, 0) & \text{if } j = us, \\ \min(-B_{chG2}, 0) & \text{if } j = ch. \end{cases} \quad (A13)$$

2) Derivation of (30)

By using (5), (A2), (A5) and (A9), one can rewrite $\frac{TA_{j1}}{P_{jT1}} = Y_{jT1} - C_{jT1} - I_{jT1} - I_{jN1}$ as

$$\frac{TA_{j1}}{P_{jT1}} = f(L_{jT1}, K_{jT1}, K_{jN1}) = K_{jT1} L_{jT1}^{\alpha_j} - \frac{(1-\eta_j)\alpha_j K_{jT1} l(L_{jT1}, K_{jT1}, K_{jN1})}{\eta_j \gamma_j L_{jT1}^{1-\alpha_j}}, \quad (A14)$$

where one can easily check that $f_{L_{jT1}} > 0$.

3) Derivation of (31)

By using (A2), (A8) and (A9), one can rewrite $C_{jt} = C_{jNt}^{\eta_j} C_{jTt}^{1-\eta_j}$ as

$$C_{jt} = c(L_{jTt}, K_{jTt}, K_{jNt}) = \frac{K_{jNt}^{\eta_j} [l(L_{jTt}, K_{jTt}, K_{jNt})]^{1-\eta_j(1-\gamma_j)} [(1-\eta_j)\alpha_j K_{jTt}]^{1-\eta_j}}{[\eta_j \gamma_j L_{jTt}^{1-\alpha_j}]^{1-\eta_j}}, \quad (A15)$$

where one can check that $c_{L_{jTt}} < 0$.

4) Derivation of (32)

By using (1), (5), (11), (A1) and (A2), one can verify that

$$\frac{GDP_{jt}}{P_{jTt}} = \frac{P_{jTt} Y_{jTt} + P_{jNt} Y_{jNt}}{P_{jt}} = \frac{\left(\frac{\gamma_j K_{jNt}}{\alpha_j} \right)^{\eta_j} D_j K_{jTt}^{1-\eta_j} L_{jTt}^{(1-\alpha_j)\eta_j + \alpha_j}}{[l(L_{jTt}, K_{jTt}, K_{jNt})]^{(1-\gamma_j)\eta_j}} \left[1 + \frac{\alpha_j l(L_{jTt}, K_{jTt}, K_{jNt})}{\gamma_j L_{jTt}} \right]. \quad (A16)$$

Considering (A2), (A16) can be rewritten as $\frac{GDP_{jt}}{P_{jTt}} = v(L_{jTt}, K_{jTt}, K_{jNt})$, where

$$v(L_{jTt}, K_{jTt}, K_{jNt}) = \begin{cases} \frac{V_{jt}}{\alpha_j} \left\{ L_{jTt} + \frac{\alpha_j \Phi_{jt}}{\gamma_j} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} \right\} & \text{if } L_{jTt}^- \leq L_{jTt} \leq L_{jTt}^+ \\ \left(\frac{\gamma_j K_{jNt}}{\alpha_j} \right)^{\eta_j} \frac{D_j K_{jTt}^{1-\eta_j} L_{jTt}^{(1-\alpha_j)\eta_j + \alpha_j}}{(H_j - L_{jTt})^{(1-\gamma_j)\eta_j}} \left[1 + \frac{\alpha_j (H_j - L_{jTt})}{\gamma_j L_{jTt}} \right] & \text{otherwise.} \end{cases}$$

Notice that $v(L_{jTt}, K_{jTt}, K_{jNt})$ is continuous in $L_{jTt} \in [0, H_j]$. Moreover, one can easily check that

$$\frac{\partial^2 \frac{V_{jt}}{\alpha_j} \left\{ L_{jTt} + \frac{\alpha_j \Phi_{jt}}{\gamma_j} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}^{1-\alpha_j}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} \right\}}{\partial L_{jTt}^2} > 0, \text{ and that there exists a unique value of } L_{jTt} \in [0, H_j], \text{ say}$$

$$L'_{jTt}, \text{ such that } \frac{\partial \left(\frac{\gamma_j K_{jNt}}{\alpha_j} \right)^{\eta_j} \frac{D_j K_{jTt}^{1-\eta_j} L_{jTt}^{(1-\alpha_j)\eta_j + \alpha_j}}{(H_j - L_{jTt})^{(1-\gamma_j)\eta_j}} \left[1 + \frac{\alpha_j (H_j - L_{jTt})}{\gamma_j L_{jTt}} \right]}{\partial L_{jTt}} \begin{cases} < 0 & \text{if } 0 \leq L_{jTt} < L'_{jTt} \\ > 0 & \text{if } H_j \geq L_{jTt} > L'_{jTt}. \end{cases} \quad \text{Thus,}$$

admitting parameter values and stocks of capital at time 1 such that $L_{jTt}^- < L'_{jTt} < L_{jTt}^+$ and

$L_{jTt}^- < \hat{L}_{jTt} < L_{jTt}^+$, where \hat{L}_{jTt} is the unique value of L_{jTt} minimizing

$$\left\{ L_{jTt} + \frac{\alpha_j \Phi_{jt}}{\gamma_j} \left[K_{jNt} \left(\frac{K_{jTt}}{L_{jTt}} \right)^{\frac{1-\eta_j}{\eta_j}} \right]^{\frac{1}{(1-\gamma_j)}} \right\}, \text{ one can conclude that } \frac{GDP_{jt}}{P_{jTt}} \text{ is decreasing in } L_{jTt} \text{ for } L_{jTt} \leq \hat{L}_{jTt}$$

and increasing in L_{jTt} for $L_{jTt} \geq \hat{L}_{jTt}$.

5) Derivation of the equilibrium relationship between the price of the tradable good and the quantity of money in period 0 and in period 1

One can use (A2) and (A12) to rewrite (A10) as $P_{jT0} = \frac{M_{j1} M_{j0} g(L_{jT0}, K_{jT0}, K_{jN0})}{(\theta_j M_{j0} + M_{j1})}$, where

$$g(L_{jT0}, K_{jT0}, K_{jN0}) = \frac{\eta_j \gamma_j L_{jT0}^{1-\alpha_j}}{\chi_j \alpha_j K_{jT0} l(L_{jT0}, K_{jT0}, K_{jN0})} \text{ and } g_{L_{jT0}} > 0.$$

Similarly, one can use (A2) to rewrite (A11) as $P_{jT1} = M_{j1} g(L_{jT1}, K_{jT1}, K_{jN1})$, where

$$g(L_{jT1}, K_{jT1}, K_{jN1}) = \frac{\eta_j \gamma_j L_{jT1}^{1-\alpha_j}}{\chi_j \alpha_j K_{jT1} l(L_{jT1}, K_{jT1}, K_{jN1})} \text{ and } g_{L_{jT1}} > 0.$$

6) Derivation of (42)

Considering (A2) and (A15), one can check that, if at time 1 the equilibrium emerging in China is characterized by the presence of unemployment, one has:

$$L_{chT1} = \bar{L}_{chT1} = \Theta_1 K_{chT1}^{\frac{1}{(1-\alpha_{ch})}} K_{chN1}^{\frac{\eta_{ch}}{(1-\alpha_{ch})(1-\eta_{ch})}}, \quad \Theta_1 \equiv \left\{ \frac{\Phi_{ch1}^{1-\eta_{ch}} (1-\gamma_{ch})}{\bar{C}_{ch1}} \left[\frac{\alpha_{ch} (1-\eta_{ch})}{\gamma_{ch} \eta_{ch}} \right]^{1-\eta_{ch}} \right\}^{\frac{\eta_{ch} (1-\gamma_{ch})}{(1-\alpha_{ch})(1-\eta_{ch})}}, \quad (A17)$$

where $\bar{L}_{chT1} < \bar{L}_{chT1} < L_{chT1}^+$. Thus, one can use (A2), (A16) and (A17) to write

$$\begin{aligned} \frac{GDP_{ch0}}{P_{ch0}} + \theta_{ch} \frac{GDP_{ch1}}{P_{ch1}} &= \frac{P_{chT0} Y_{chT0} + P_{chN0} Y_{chN0}}{P_{ch0}} + \theta_{ch} \left(\frac{P_{chT1} Y_{chT1} + P_{chN1} Y_{chN1}}{P_{ch1}} \right) \text{ as} \\ \frac{GDP_{ch0}}{P_{ch0}} + \theta_{ch} \frac{GDP_{ch1}}{P_{ch1}} &= \left(\frac{\gamma_{ch} K_{chN0}}{\alpha_{ch}} \right)^{\eta_{ch}} \frac{D_{ch} K_{chT0}^{1-\eta_{ch}} L_{chT0}^{(1-\alpha_{ch})\eta_{ch} + \alpha_{ch}}}{[l(L_{chT0}, K_{chT0}, K_{chN0})]^{(1-\gamma_{ch})\eta_{ch}}} \left[1 + \frac{\alpha_{ch} l(L_{chT0}, K_{chT0}, K_{chN0})}{\gamma_{ch} L_{chT0}} \right] + \\ &+ \frac{\theta_{ch} V_{ch1}}{\alpha_{ch}} \left\{ \Theta_1 K_{chT1}^{\frac{1}{(1-\alpha_{ch})}} K_{chN1}^{\frac{\eta_{ch}}{(1-\alpha_{ch})(1-\eta_{ch})}} + \frac{\alpha_{ch} \Phi_{ch1}}{\gamma_{ch}} \left(\frac{1}{\Theta_1} \right)^{\frac{(1-\alpha_{ch})(1-\eta_{ch})}{\eta_{ch} (1-\gamma_{ch})}} \right\}. \quad (A18) \end{aligned}$$

The stocks of capital in period 1 depend on the investment decisions made in 0. Assuming that in country j

there is unemployment in period 1, and taking into account of $P_{jT0} = \frac{M_{j1}M_{j0}g(L_{jT0}, K_{jT0}, K_{jN0})}{(\theta_j M_{j0} + M_{j1})}$,

$P_{jT1} = M_{j1}g(L_{jT1}, K_{jT1}, K_{jN1})$, (A1), (A2), (A3) and (A12), one can rewrite the first-order conditions with respect to the investment rate in the two sectors (equations (A6) and (A7)) as, respectively,

$$\left(\frac{K_{jT1}}{L_{jT1}^{1-\alpha_j}} \right)^{\frac{1-\gamma_j\eta_j}{(1-\gamma_j)\eta_j}} \frac{\frac{1}{K_{jN1}^{(1-\gamma_j)}\Phi_{j1}L_{jT0}^{1-\alpha_j}}}{\theta_j K_{jT0}l(L_{jT0}, K_{jT0}, K_{jN0})} = (1-\alpha_j)L_{jT1}^{\alpha_j} \quad (A19)$$

and

$$\left(\frac{K_{jT1}}{L_{jT1}^{1-\alpha_j}} \right)^{\frac{1-\gamma_j\eta_j}{(1-\gamma_j)\eta_j}} \frac{\frac{1}{K_{jN1}^{(1-\gamma_j)}\Phi_{j1}L_{jT0}^{1-\alpha_j}}}{\theta_j K_{jT0}l(L_{jT0}, K_{jT0}, K_{jN0})} = (1-\gamma_j) \left(\frac{\gamma_j D_j K_{jN1}}{V_{j1}} \right)^{\frac{\gamma_j}{(1-\gamma_j)}} \left[\frac{\alpha_j \Phi_{j1}^{1-\gamma_j}}{\gamma_j} \left(\frac{K_{jT1}}{L_{jT1}^{1-\alpha_j}} \right)^{\frac{1}{\eta_j}} \right]^{\frac{1-\gamma_j\eta_j}{(1-\gamma_j)}}. \quad (A20)$$

Equation (A20) can be rearranged as

$$K_{jN1} = \frac{\Psi_j l(L_{jT0}, K_{jT0}, K_{jN0}) K_{jT0}}{L_{jT0}^{1-\alpha_j}}, \quad \Psi_j \equiv \frac{(1-\gamma_j)\theta_j}{\Phi_{j1}^{\gamma_j\eta_j}} \left(\frac{\gamma_j D_j}{V_{j1}} \right)^{\frac{\gamma_j}{(1-\gamma_j)}} \left(\frac{\alpha_j}{\gamma_j} \right)^{\frac{1-\gamma_j\eta_j}{(1-\gamma_j)}}. \quad (A21)$$

By using (A21), one can rewrite (A19) as

$$K_{jT1} = \Xi_j \left(\frac{L_{jT0}^{1-\alpha_j}}{l(L_{jT0}, K_{jT0}, K_{jN0}) K_{jT0}} \right)^{\frac{\gamma_j\eta_j}{(1-\gamma_j)\eta_j}} \frac{(1-\gamma_j)\eta_j\alpha_j + 1 - \alpha_j}{L_{jT1}^{(1-\gamma_j)\eta_j}}, \quad \Xi_j \equiv \left[\frac{(1-\alpha_j)\theta_j}{\Phi_{j1}\Psi_j^{\frac{1}{(1-\gamma_j)}}} \right]^{\frac{(1-\gamma_j)\eta_j}{(1-\gamma_j)\eta_j}}. \quad (A22)$$

In the case of China, one can use (A17) and (A21) to substitute for L_{jT1} , thus rearranging (A22) as

$$K_{chT1} = \left(\frac{L_{chT0}^{1-\alpha_{ch}}}{l(L_{chT0}, K_{chT0}, K_{chN0}) K_{chT0}} \right)^{\frac{1-\alpha_{ch}(1-\eta_{ch})}{(1-\eta_{ch})\alpha_{ch}}} \Omega_{ch}, \quad (A23)$$

$$\text{where } \Omega_{ch} \equiv \left(\Theta_1^{\frac{(1-\alpha_{ch})}{\eta_{ch}}} \Psi_{ch}^{\frac{1}{(1-\eta_{ch})}} \right)^{\frac{-[1-\alpha_{ch}+\eta_{ch}(\alpha_{ch}-\gamma_{ch})]}{(1-\gamma_{ch})\alpha_{ch}}} \left[\frac{\Phi_{ch1}\Psi_{ch}^{\frac{1}{(1-\gamma_{ch})}}}{(1-\alpha_{ch})\theta_{ch}} \right]^{\frac{(1-\alpha_{ch})}{\alpha_{ch}}}.$$

Finally, one can use (A2), (A21) and (A23) to rewrite (A17) as

$$\bar{L}_{chT1} = \Lambda \left[\frac{1}{K_{chN0}} \left(\frac{L_{chT0}^{1-\alpha_{ch}}}{K_{chT0}} \right)^{\frac{1-\eta_{ch}\gamma_{ch}}{\eta_{ch}}} \right]^{\frac{1}{(1-\eta_{ch})(1-\gamma_{ch})\alpha_{ch}}}, \quad \Lambda \equiv \frac{\Theta_1}{\frac{1}{\Phi_{ch0}^{(1-\eta_{ch})\alpha_{ch}}}} \left(\Omega_{ch} \Psi_{ch}^{\frac{\eta_{ch}}{(1-\eta_{ch})}} \right)^{\frac{1}{(1-\alpha_{ch})}}, \quad (A24)$$

and (A18) as $\frac{GDP_{ch0}}{P_{ch0}} + \theta_{ch} \frac{GDP_{ch1}}{P_{ch1}} = b(L_{chT0}, K_{chT0}, K_{chN0})$, where

$$b(L_{chT0}, K_{chT0}, K_{chN0}) = \left(\frac{\gamma_{ch}}{\alpha_{ch}} \right)^{\eta_{ch}} \frac{D_{ch}}{\Phi_{ch0}^{(1-\gamma_{ch})\alpha_{ch}}} \left\{ L_{chT0} + \frac{\alpha_{ch} \Phi_{ch0}}{\gamma_{ch}} \left[K_{chN0} \left(\frac{K_{chT0}}{L_{chT0}} \right)^{\frac{1-\eta_{ch}}{\eta_{ch}}} \right]^{\frac{1}{(1-\gamma_{ch})}} \right\} +$$

$$+ \frac{\theta_{ch} V_{ch1}}{\alpha_{ch}} \left\{ \Lambda \left[\frac{1}{K_{chN0}} \left(\frac{L_{chT0}^{1-\alpha_{ch}}}{K_{chT0}} \right)^{\frac{1-\eta_{ch}\gamma_{ch}}{\eta_{ch}}} \right]^{\frac{1}{(1-\eta_{ch})(1-\gamma_{ch})\alpha_{ch}}} + \frac{\alpha_{ch} \Phi_{ch1}}{\gamma_{ch} \Theta_1 \frac{\eta_{ch}(1-\gamma_{ch})}{(1-\alpha_{ch})(1-\eta_{ch})}} \right\}, \quad L_{chT0}^- \leq L_{chT0} \leq L_{chT0}^+. \quad (A25)$$

Notice that we consider parameter values and initial conditions such that the presence of unemployment in China at time 0 ($L_{chT0}^- < L_{chT0} < L_{chT0}^+$) implies that also at time 1 China will have unemployment

$$\left(L_{chT1}^- < \bar{L}_{chT1} = \Lambda \left[\frac{1}{K_{chN0}} \left(\frac{L_{chT0}^{1-\alpha_{ch}}}{K_{chT0}} \right)^{\frac{1-\eta_{ch}\gamma_{ch}}{\eta_{ch}}} \right]^{\frac{1}{(1-\eta_{ch})(1-\gamma_{ch})\alpha_{ch}}} < L_{chT1}^+ \right). \text{ Moreover, these parameter values and}$$

initial conditions are such that $L_{chT0}^- < \tilde{L}_{chT0} < L_{chT0}^+$, where \tilde{L}_{chT0} is the unique value of L_{chT0} minimizing

$$b(L_{chT0}, K_{chT0}, K_{chN0}). \text{ Since it can be checked that } \frac{\partial b(L_{chT0}, K_{chT0}, K_{chN0})}{\partial L_{chT0}} \begin{cases} < 0 \text{ if } L_{chT0}^- \leq L_{chT0} < \tilde{L}_{chT0} \\ > 0 \text{ if } L_{chT0}^+ \geq L_{chT0} > \tilde{L}_{chT0}, \end{cases}$$

one can conclude that $\frac{GDP_{ch0}}{P_{ch0}} + \theta_{ch} \frac{GDP_{ch1}}{P_{ch1}}$ is decreasing in L_{chT0} for $L_{chT0}^- \leq L_{chT0} < \tilde{L}_{chT0}$ and

increasing in L_{chT0} for $L_{chT0}^+ \geq L_{chT0} > \tilde{L}_{chT0}$.

$$\text{7) Conditions under which i) } \frac{\partial \frac{TA_{ch0}}{P_{chT0}}}{\partial L_{chT0}} > 0, \text{ ii) } \frac{\partial L_{usT0}}{\partial L_{chT0}} < 0, \text{ and iii) } \frac{\partial C_{us0} + \theta_{us} C_{us1}}{\partial L_{usT0}} < 0 \text{ hold}$$

i) By using (3), (5), (7), (A2), (A9), (A21) and (A23), one can rewrite $\frac{TA_{ch0}}{P_{chT0}} = Y_{chT0} - C_{chT0} - I_{chT0} - I_{chN0}$

as $\frac{TA_{ch0}}{P_{chT0}} = r(L_{chT0}, K_{chT0}, K_{chN0})$, where

$$\begin{aligned} r(L_{chT0}, K_{chT0}, K_{chN0}) = & K_{chT0} L_{chT0}^{\alpha_{ch}} - \left[\frac{(1-\eta_{ch})\alpha_{ch}}{\eta_{ch}\gamma_{ch}} + \Psi_{ch} \right] \Phi_{ch0} K_{chN0}^{\frac{1}{1-\gamma_{ch}}} \left(\frac{K_{chT0}}{L_{chT0}^{1-\alpha_{ch}}} \right)^{\frac{1-\eta_{ch}\gamma_{ch}}{\eta_{ch}(1-\gamma_{ch})}} - \\ & - \Omega_{ch} \left[\Phi_{ch0} K_{chN0}^{\frac{1}{1-\gamma_{ch}}} \left(\frac{K_{chT0}}{L_{chT0}^{1-\alpha_{ch}}} \right)^{\frac{1-\eta_{ch}\gamma_{ch}}{\eta_{ch}(1-\gamma_{ch})}} \right]^{\frac{\alpha_{ch}(1-\eta_{ch})-1}{(1-\eta_{ch})\alpha_{ch}}} + (1-\delta_{ch})(K_{chN0} + K_{chT0}) \end{aligned} \quad (A26)$$

and $L_{chT0}^- \leq L_{chT0} \leq L_{chT0}^+$.

Given $\alpha_{ch} < \gamma_{ch}$, it is necessarily the case that $\frac{\partial^2 r(L_{chT0}, K_{chT0}, K_{chN0})}{\partial L_{chT0}^2} < 0$. Hence,

$$\frac{\partial r(L_{chT0}, K_{chT0}, K_{chN0})}{\partial L_{chT0}} > 0 \Big|_{L_{chT0} = L_{chT0}^+} \text{ implies that } \frac{\partial r(L_{chT0}, K_{chT0}, K_{chN0})}{\partial L_{chT0}} > 0 \text{ for any } L_{chT0} \text{ such that}$$

$L_{chT0}^- \leq L_{chT0} \leq L_{chT0}^+$. Thus, parameter values and initial conditions consistent with

$$\frac{\partial r(L_{chT0}, K_{chT0}, K_{chN0})}{\partial L_{chT0}} > 0 \Big|_{L_{chT0} = L_{chT0}^+} \text{ guarantee that } \frac{\partial \frac{TA_{ch0}}{P_{chT0}}}{\partial L_{chT0}} > 0 \text{ holds for any } L_{chT0} \text{ such that}$$

$L_{chT0}^- \leq L_{chT0} \leq L_{chT0}^+$.

ii) By using (3), (5), (7), (A2), (A9) and (A21), one can rewrite $\frac{TA_{us0}}{P_{usT0}} = Y_{usT0} - C_{usT0} - I_{usT0} - I_{usN0}$ as

$$\begin{aligned} \frac{TA_{us0}}{P_{usT0}} = & K_{usT0} L_{usT0}^{\alpha_{us}} - \left[\frac{(1-\eta_{us})\alpha_{us}}{\eta_{us}\gamma_{us}} + \Psi_{us} \right] \Phi_{us0} K_{usN0}^{\frac{1}{1-\gamma_{us}}} \left(\frac{K_{usT0}}{L_{usT0}^{1-\alpha_{us}}} \right)^{\frac{1-\eta_{us}\gamma_{us}}{\eta_{us}(1-\gamma_{us})}} - \\ & - K_{usT1} + (1-\delta_{us})(K_{usN0} + K_{usT0}), \end{aligned} \quad (A27)$$

where $L_{usT0}^- \leq L_{usT0} \leq L_{usT0}^+$. Notice that in (A27) we consider parameter values and initial conditions such

that $L_{usT0}^- \leq L_{usT0} \leq L_{usT0}^+$ entails $L_{usT1}^- \leq L_{usT1} \leq L_{usT1}^+$.

Considering that in equilibrium $\frac{TA_{us0}}{P_{usT0}} + \frac{TA_{ch0}}{P_{chT0}} = 0$, one can use (A26) and (A27) to obtain

$K_{usT1} = z(L_{usT0}, K_{usT0}, K_{usN0}, L_{chT0}, K_{chT0}, K_{chN0})$, where

$$z(L_{usT0}, K_{usT0}, K_{usN0}, L_{chT0}, K_{chT0}, K_{chN0}) = K_{usT0} L_{usT0}^{\alpha_{us}} + (1 - \delta_{us})(K_{usN0} + K_{usT0}) - \left[\frac{(1 - \eta_{us})\alpha_{us}}{\eta_{us}\gamma_{us}} + \Psi_{us} \right] \Phi_{us0} K_{usN0}^{\frac{1}{(1-\gamma_{us})}} \left(\frac{K_{usT0}}{L_{usT0}^{1-\alpha_{us}}} \right)^{\frac{1-\eta_{us}\gamma_{us}}{\eta_{us}(1-\gamma_{us})}} + r(L_{chT0}, K_{chT0}, K_{chN0}) \quad (A28)$$

and $L_{usT0}^- \leq L_{usT0} \leq L_{usT0}^+$. One can easily verify that $\frac{\partial z(\cdot)}{\partial L_{usT0}} > 0$ and $\frac{\partial z(\cdot)}{\partial L_{chT0}} > 0$ (since

$\frac{\partial r(L_{chT0}, K_{chT0}, K_{chN0})}{\partial L_{chT0}} > 0$). Moreover, by considering (A2) and (A22), one can use (A28) to obtain

$$L_{usT1} = \left\{ \frac{z(L_{usT0}, K_{usT0}, K_{usN0}, L_{chT0}, K_{chT0}, K_{chN0})}{\Xi_{us} \left[\frac{-1}{K_{usN0}^{\frac{1}{(1-\gamma_{us})}}} \left(\frac{L_{usT0}^{1-\alpha_{us}}}{K_{usT0}} \right)^{\frac{1-\eta_{us}\gamma_{us}}{\eta_{us}(1-\gamma_{us})}} \right]^{\frac{\gamma_{us}\eta_{us}}{(1-\gamma_{us}\eta_{us})}}} \right\}^{\frac{1-\gamma_{us}\eta_{us}}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]}} \quad (A29)$$

One can now use (A2), (A21), (A28) and (A29) to rewrite (A14) as

$$\frac{TA_{us1}}{P_{usT1}} = Y_{usT1} - C_{usT1} = \left\{ z(\cdot) \Xi_{us}^{-1} \left[\Phi_{us0} K_{usN0}^{\frac{1}{(1-\gamma_{us})}} \left(\frac{K_{usT0}}{L_{usT0}^{1-\alpha_{us}}} \right)^{\frac{1-\eta_{us}\gamma_{us}}{\eta_{us}(1-\gamma_{us})}} \right]^{\frac{\gamma_{us}\eta_{us}}{(1-\gamma_{us}\eta_{us})}}} \right\}^{\frac{\alpha_{us}(1-\gamma_{us}\eta_{us})}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]}} \{ z(\cdot) - \frac{(1-\eta_{us})\alpha_{us}\Phi_{us1}\Psi_{us}^{\frac{1}{(1-\gamma_{us})}}}{\eta_{us}\gamma_{us}} \left[\Xi_{us}^{\frac{1}{\eta_{us}(1-\gamma_{us})}} \left(\Phi_{us0} K_{usN0}^{\frac{1}{(1-\gamma_{us})}} \right)^{\frac{[(1-\gamma_{us}\eta_{us}-\alpha_{us})(1-\eta_{us})]}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]}} \right] \left(\frac{K_{usT0}}{L_{usT0}^{1-\alpha_{us}}} \right)^{\frac{1-\eta_{us}\gamma_{us}}{\eta_{us}(1-\gamma_{us})}} \right\}, \quad (A30)$$

where $L_{usT0}^- \leq L_{usT0} \leq L_{usT0}^+$. One can check that

$$\frac{\partial}{\partial L_{usT0}} \frac{TA_{us1}}{P_{usT1}} = \frac{\partial z(\cdot)}{\partial L_{usT0}} \left[\frac{Y_{usT1}}{z(\cdot)} + \left(\frac{Y_{usT1} - C_{usT1}}{z(\cdot)} \right) \frac{\alpha_{us}(1-\gamma_{us}\eta_{us})}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]} \right] + \frac{(1-\alpha_{us})(1-\eta_{us}\gamma_{us})}{\eta_{us}(1-\gamma_{us})} \left[\frac{C_{usT1}}{L_{usT0}} - \left(\frac{Y_{usT1} - C_{usT1}}{L_{usT0}} \right) \frac{\alpha_{us}\gamma_{us}\eta_{us}}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]} \right]. \quad (A31)$$

By considering that $\frac{\partial z(\cdot)}{\partial L_{usT0}} > 0$ and that the difference $Y_{usT1} - C_{usT1}$ is relatively small with respect to both

Y_{usT1} and C_{usT1} , one can conclude that for relevant ranges of parameter values and initial conditions

$\frac{\partial \frac{TA_{us1}}{P_{usT1}}}{\partial L_{usT0}} > 0$. A similar conclusion can be reached for China by using (A2), (A14), (A17), (A21) and (A23)

to rewrite $\frac{TA_{ch1}}{P_{chT1}}$ as a function of L_{chT0} , K_{chN0} and K_{chT0} :

$$\begin{aligned} \frac{TA_{ch1}}{P_{chT1}} = Y_{chT1} - C_{chT1} = & \left\{ \Omega_{ch} \Phi_{ch0}^{\frac{\alpha_{ch}(1-\eta_{ch})-1}{(1-\eta_{ch})\alpha_{ch}}} \Lambda^{\alpha_{ch}} \left[\frac{1}{K_{chN0}} \left(\frac{L_{chT0}^{1-\alpha_{ch}}}{K_{chT0}} \right)^{\frac{1-\eta_{ch}\gamma_{ch}}{\eta_{ch}}} \right]^{\frac{1}{(1-\gamma_{ch})(1-\eta_{ch})\alpha_{ch}}} \right. \\ & \left. - \frac{(1-\eta_{ch})\alpha_{ch}\Phi_{ch1}\Theta_1}{\eta_{ch}\gamma_{ch}(\Psi_{ch}\Phi_{ch0})^{\frac{\eta_{ch}}{(1-\eta_{ch})}}} \left[\frac{1}{K_{chN0}} \left(\frac{L_{chT0}^{1-\alpha_{ch}}}{K_{chT0}} \right)^{\frac{1-\eta_{ch}\gamma_{ch}}{\eta_{ch}}} \right]^{\frac{\alpha_{ch}\eta_{ch}}{(1-\gamma_{ch})(1-\eta_{ch})\alpha_{ch}}} \right], \end{aligned} \quad (A32)$$

where $L_{chT0}^- \leq L_{chT0} \leq L_{chT0}^+$. Indeed, one can check that

$$\frac{\partial \frac{TA_{ch1}}{P_{chT1}}}{\partial L_{chT0}} = \frac{(1-\alpha_{ch})(1-\eta_{ch}\gamma_{ch})}{\alpha_{ch}\eta_{ch}(1-\gamma_{ch})(1-\eta_{ch})} \left[\frac{Y_{usT1}}{L_{usT0}} + \alpha_{ch}\eta_{ch} \left(\frac{Y_{chT1} - C_{chT1}}{L_{chT0}} \right) \right]. \quad (A33)$$

Again, one can conclude that for relevant ranges of parameter values and initial conditions $\frac{\partial \frac{TA_{ch1}}{P_{chT1}}}{\partial L_{chT0}} > 0$.

Finally, one can verify that

$$\frac{\partial \frac{TA_{us1}}{P_{usT1}}}{\partial L_{chT0}} = \frac{\partial z(\cdot)}{\partial L_{chT0}} \left[\frac{Y_{usT1}}{z(\cdot)} + \left(\frac{Y_{usT1} - C_{usT1}}{z(\cdot)} \right) \frac{\alpha_{us}(1-\gamma_{us}\eta_{us})}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]} \right], \quad (A34)$$

thus concluding that $\frac{\partial \frac{TA_{us1}}{P_{usT1}}}{\partial L_{chT0}} > 0$.

Since in equilibrium $\frac{TA_{us1}}{P_{usT1}} + \frac{TA_{ch1}}{P_{chT1}} = 0$, one can express L_{usT0} as an implicit function of L_{chT0} and of the

initial conditions: $L_{usT0} = x(L_{chT0}, K_{chN0}, K_{chT0}, K_{usN0}, K_{usT0})$, where $\frac{TA_{us1}}{P_{usT1}}$ and $\frac{TA_{ch1}}{P_{chT1}}$ are given,

respectively, by (A30) and (A32) (similarly, one can express L_{chT0} as an implicit function of L_{usT0} and of the initial conditions: $L_{chT0}=m(L_{usT0},K_{chN0},K_{chT0},K_{usN0},K_{usT0})$). Considering (A31), (A33) and (A34), one can conclude that $x_{L_{chT0}} < 0$ (or that $m_{L_{usT0}} < 0$), thus implying that given the equilibrium that will emerge in period 1 one has $\frac{\partial L_{usT0}}{\partial L_{chT0}} < 0$.

iii) By using (A2), (A15), (A21), (A28) and (A29), one can rewrite $C_{us0} + \theta_{us}C_{us1}$ as

$$w(L_{usT0}, K_{usT0}, K_{usN0}, K_{usT0}, K_{usN0}) = \left[\frac{(1-\eta_{us})\alpha_{us}}{\eta_{us}\gamma_{us}} \right]^{1-\eta_{us}} \left\{ \Phi_{us0}^{1-\eta_{us}(1-\gamma_{us})} \left(\frac{K_{usT0}}{L_{usT0}^{1-\alpha_{us}}} \right)^{\frac{1-\eta_{us}}{\eta_{us}(1-\gamma_{us})}} K_{usN0}^{\frac{1}{(1-\gamma_{us})}} + \right. \\ \left. + \frac{\theta_{us} \Phi_{us1}^{1-\eta_{us}(1-\gamma_{us})}}{\Psi_{us}^{(1-\gamma_{us})}} \left[\Xi_{us} \frac{(1-\gamma_{us}\eta_{us})(1-\alpha_{us})}{\eta_{us}(1-\gamma_{us})} [z(L_{usT0}, K_{usT0}, K_{usN0}, m(\cdot), K_{chT0}, K_{chN0})]^{\alpha_{us}} \right]^{\frac{(1-\eta_{us})}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]}} \right\} \quad (A35) \\ + \frac{1}{\left[\Phi_{us0} K_{usN0}^{\frac{1}{(1-\gamma_{us})}} \left(\frac{K_{usT0}}{L_{usT0}^{1-\alpha_{us}}} \right)^{\frac{1-\eta_{us}\gamma_{us}}{\eta_{us}(1-\gamma_{us})}} \right]^{1-\gamma_{us}} \left[\frac{(1-\gamma_{us}\eta_{us})(1-\alpha_{us})(1-\eta_{us})}{[1-\alpha_{us}-\eta_{us}(\gamma_{us}-\alpha_{us})]\eta_{us}} - 1 \right]}}$$

where $L_{usT0}^- \leq L_{usT0} \leq L_{usT0}^+$. As we know from (A15), the effect of a larger L_{usT0} on current consumption is negative, while its effect on next-period consumption is in principle ambiguous. Indeed, by inspecting (A35), one can observe that L_{usT0} affects C_{us1} through two channels: it has an indirect effect on it via its impact on $K_{usT1}=z(\cdot)$ and a direct effect on it via its impact on $\frac{K_{usT0}}{L_{usT0}^{1-\alpha_{us}}}$. In its turn, a larger L_{usT0} determines an increase in K_{usT1} by boosting the domestic production of tradables in period 0, but this effect of a larger L_{usT0} on K_{usT1} tends to be offset by the reduction in that period of the US import of tradables from China ($z_{L_{chT0}} m_{L_{usT0}} < 0$). In contrast, the direct effect of a larger L_{usT0} on C_{us1} is unambiguously negative for a country where households dedicate more than a modest fraction of their total consumer expenditures to the purchase of nontradables (which turns to be the case for the US), i.e., this effect is strictly negative if

$$\eta_{us} > \underline{\eta}_{us} = \frac{(2+\gamma_{us})(1-\alpha_{us})}{2[2\gamma_{us}-\alpha_{us}(1+\gamma_{us})]} - \left\{ \frac{[(2+\gamma_{us})(1-\alpha_{us})]^2}{4[2\gamma_{us}-\alpha_{us}(1+\gamma_{us})]^2} - \frac{(1-\alpha_{us})}{[2\gamma_{us}-\alpha_{us}(1+\gamma_{us})]} \right\}^{\frac{1}{2}} < \frac{1}{2}. \quad (A36)$$

Hence, we should expect that for relevant ranges of parameter values and initial conditions

$$\frac{\partial C_{\text{us}0} + \theta_{\text{us}} C_{\text{us}1}}{\partial L_{\text{us}T0}} < 0.$$

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